CHAPTER 8

Case Studies

This chapter describes the P2 practices implemented by two PFPR facilities. The first facility, operated by Ennis Agrotech and located in Ennis, Texas, is a formulator and packager of agricultural products. Ennis Agrotech uses a variety of P2 techniques, such as reuse of treated wastewaters, to achieve zero discharge of PFPR process wastewaters. The second facility, operated by MGK (McLaughlin Gormley King Company), was constructed in 1992 in Chaska, Minnesota, and illustrates how new facilities can incorporate P2 opportunities into their design.

In each case study, the following information is presented:

- An overview of the facility;
- A description of the PFPR operations, including wastewater generation; and
- A discussion of the P2 techniques implemented by the facility.

Each case study was prepared from information collected during site visits and through follow-up telephone calls with facility personnel. *This information was correct at the time of development of the final rule, but operations may have changed since that time.* The P2 practices implemented and their benefits are solely based on the opinions of the facilities presented here. Specific P2 practices and equipment presented in the case studies in ***italicized bold*** print are defined in the P2 glossary in Chapter 3.

Case Study 1: Ennis Agrotech, Ennis, Texas

Facility Overview

Ennis Agrotech, formerly Agriculture Warehouse, operates a contract (or toll) PFPR facility that does not produce or market its own labeled products. Instead, the facility formulates registered pesticide products for about 20 domestic and foreign companies. These companies supply Ennis Agrotech with the necessary raw materials, product recipes, and packaging and labels required to make the final product. Ennis Agrotech assembles a production line using the customer's bench-scale process as a guide, formulates and packages the product, and then turns the product over to the customer's marketing division. The production line consists of equipment from Ennis Agrotech's inventory as well as custom-designed equipment manufactured as needed by a local machine shop.

PFPR Operations

The facility operates eight independent process lines to formulate and package both liquid and solid pesticide products. The list of formulated products varies over time due to changing contracts; however, Ennis Agrotech attempts to schedule formulating and packaging contracts such that only compatible pesticide products are being produced at the same time.

The eight production areas operated at the facility (termed "manufacturing modules" by Ennis Agrotech) are individually configured to handle a certain type, or formulation, of pesticide product. The equipment setup in each of the process areas can be reconfigured to formulate new products. New formulation and packaging lines usually consist of a combination of existing and new custom-designed equipment. Existing equipment is refurbished, pressure-washed in a curbed area (if necessary), and stored in a warehouse building (called the machine shop) when it is not being used on one of the process lines. At the time this manual was written, Ennis Agrotech was conducting formulating, packaging, and repackaging operations in the following eight production areas:

- The first manufacturing module is used to formulate and package mosquito growth-regulator briquets. To produce the briquets, an insecticide is mixed with carbon and gypsum cement, poured into plastic trays with numerous quarter-sized molds, cured, and packaged.
- The second manufacturing module is a semiautomated line used to produce various dry animal health products containing carbaryl and/or phosmet. The products are formulated in grinding and milling equipment, stored in tote bags, sampled and analyzed to assure compliance with product specifications, and packaged.
- The third manufacturing module is a pilot plant configured to formulate and package a product that is used on cow ear tags. A liquid active ingredient is combined with other raw ingredients in a mixer and then sprayed onto a clay or granular carrier in a Munson blender.
- The fourth manufacturing module is used to formulate and package a fire ant control product. Liquid active ingredient is mixed in a kettle and sprayed onto granulated clay material in a Continental blender. The product is then lifted by an elevator into a hopper, screened to filter out oversized particles, and packaged into bags.
- The fifth manufacturing module, called the "Pellet Mill System," is used to produce pelletized aquatic and pasture herbicides. Active ingredients mixed with water, binding agents, and dispersion agents are sprayed onto a solid carrier as it is mixed in a Marion paddle blender. The formulated product is transferred via a conveyor to a mill where it is pelletized. The pellets are either packaged "raw" or coated with sulfonates (a pulp and paper industry byproduct) that act as a water-soluble coating to minimize dust generation during pellet handling. The raw or coated pellets are gravity fed through an elevator to a hopper and then packaged

into bags. Due to the large volume of water incorporated into the product during the formulating and pelletizing process, the facility uses a combination of city water and treated water, which is stored in a 5,000-gallon tank located outside of the laboratory. The finished product contains 15 to 18% water.

- The sixth manufacturing module is used to repackage a finished dry product supplied by the client company from bulk containers to smaller containers. The product is removed from 2,000-pound tote bags, agitated if necessary, and packaged into smaller containers, such as 2-pound application packs.
- The seventh manufacturing module is used to produce a greenhouse insecticide product that controls spider mites. The active ingredient is mixed with three solvents in the first of three steel formulation vessels operated in series. The product is transferred to the second vessel where it is tested. Necessary formulation adjustments are made in this vessel if the product is found to be off-spec. The product is then transferred to the third vessel where it is held for packaging.
- The eighth manufacturing module is the facility's primary liquid production area. The line is currently configured to formulate and package a solvent-based insecticide for use on cotton crops.

P2 Practices

Ennis Agrotech generates pesticide-containing wastewater from four sources: (1) interior equipment cleaning; (2) exterior equipment cleaning and floor washing; (3) drum and shipping container rinsing; and (4) spill and leak cleanups. The facility uses a local Texas-certified laboratory to analyze all raw materials, products, and wastes; as a result, no laboratory wastewater is generated on site. The facility has a stormwater runoff contingency plan, but does not currently collect precipitation.

Ennis Agrotech achieves zero discharge of all PFPR process wastewater through a variety of P2 practices and wastewater management techniques. The benefits associated with these practices include:

1. Enhanced reputation with their customers, due to the reduction of cross-contamination liability;
2. Reduced raw material (i.e., active and inert formulation ingredients) costs due to the recovery of these materials during equipment cleanouts; and
3. Positive relationships with local community and with state and federal regulatory agencies.

Specifically, Ennis Agrotech uses the following P2 practices:

Interior Equipment Cleaning—Process wastewater associated with the formulating and packaging of a given product is minimized through the ***dedication of equipment***, the use of ***dry process cleaning equipment***, and water washes using ***flow reduction equipment***. In addition, effective ***inventory management*** practices enable the facility to maximize ***interior rinsate storage and reuse***.

Ennis Agrotech dedicates manufacturing modules to specific pesticide classes, such as fungicides, herbicides, and insecticides, in order to minimize the potential for cross-contamination between pesticide classes and to minimize the number of product changeover cleaning operations. In addition, when making products within the same pesticide class, formulating and packaging equipment is cleaned before product changeover occurs to allay cross-contamination concerns, and at set intervals during production, if needed. Typically, equipment used to formulate water-dispersible granular products only requires vacuum cleaning, while equipment used to formulate pellet products usually requires water washing. The cleaning processes depend on the compatibility of the pesticide products, and range in scope from multiple rinses to breaking down all equipment and cleaning to nondetect levels for active ingredients.

Interior equipment cleaning due to a product changeover within a pesticide class consists of scraping with wire brushes, flushing with the formulation carrier (such as sand, limestone, or clay) or a solvent wash, and if product residue or other buildup remains in the equipment, washing with water using high-pressure (3,500 pounds per square inch)/low-volume (1 gallon per minute) equipment. About 70 to 80% of the changeovers only require dry cleaning. The flushed formulation carrier is stored and reused in the next formulation. If the high-pressure wash step is required, approximately 30 to 35 gallons of water are used to clean the interior of the mixing system. In some cases, rinsates from interior equipment cleaning operations are collected and stored for reuse in a subsequent batch of the product.

Ennis Agrotech manages wastewater (and solid waste) reuse with the same computerized inventory management control system used to track the storage and use of all raw materials. This system is maintained by management personnel assisted by a "waste movement" consultant. Equipment cleanouts are documented on "Pre-Cleanout and Decontamination Checklists" (shown in Figure 8-1). Separate forms are used for each unit and product. Wastes generated during these cleanouts (including wash water, solvents, and dry formulation carriers) are collected, weighed, labeled, and stored in the manufacturing module; the information is entered into the computer system. When that product is formulated, the computer generates a production sheet for that batch, which tells the operator how much raw material to use, including the amount of stored cleaning material.

For example, production in the Pellet Mill system (Figure 8-2) uses a large amount of dry carrier left from cleaning as raw formulation materials, as well as cleaning rinsates. The Pellet Mill cleanout procedures are documented on a checklist (Figure 8-3) that clearly indicates how each piece of equipment is cleaned, the type of cleaning materials used, and how the residual cleaning materials are to be handled.

AGRICULTURE WAREHOUSE, INC.

Pre-Cleanout/Decontamination Checklist

Room # _____ Date _____

1. Electrical lockout/tagout procedures have been reviewed
By _____

2. Confined space entry procedures have been reviewed
By _____

3. Proper procedures for containing, drumming, and labeling for disposal of all rinse water have been reviewed
By _____

4. Proper procedures for packaging, labeling, and sampling (if necessary) of all solid material collected have been reviewed
By _____

5. The following special instructions and/or procedures were covered:

By _____
Management Approval By _____

Figure 8-1. General Pre-Cleanout/ Decontamination Checklist

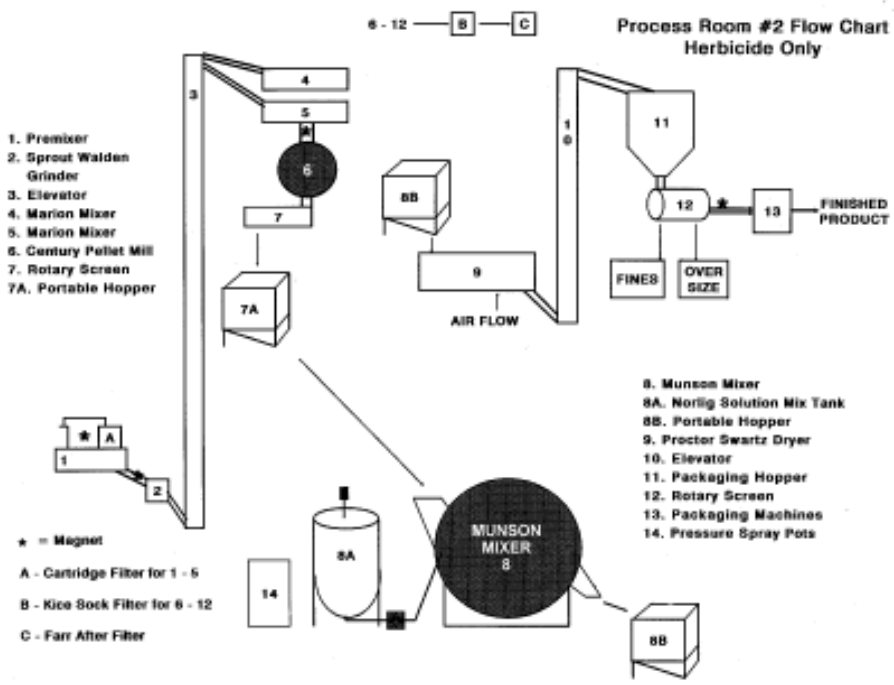

Figure 8-2 Pellet Mill System

Cleaning water from the Pellet Mill production area is stored in a 5,000-gallon bulk tank and treated prior to the next production run of the same product. The cleaning water is treated using a microfiltration unit followed by an activated carbon filter system. The microfiltration unit is a vertical, poly-type, cross-flow filtration system manufactured by EPOC Water Systems of Fresno, California. The Pellet Mill System uses approximately 12,000 gallons of water during each production campaign, of which up to 4,000 gallons is recycled wastewater; the balance is fresh make-up water.

The Pellet Mill system cleaning material reuse "cycle" is illustrated in Figure 8-4.

Exterior Equipment Cleaning—Exterior equipment cleaning wash water and floor wash water are controlled in the same way as the interior equipment cleaning rinsates. These wash waters are generated during product changeover (the facility vacuums the floors and walls at all other times). The floors and walls are washed with water from a high-pressure hose. The entire cleaning process (including both interior and exterior cleaning) usually requires between 30 and 75 gallons of water. Wastewater generated during product changeover

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Room 2 Pellet Mill Clean & Flush

1. PRE-CLEAN

by _____ a. Scrape & sweep out pre-mixer
by _____ b. Scrape & sweep out blenders #1 & #2
by _____ c. Scrape & sweep out elevators
by _____ d. Scrape & sweep out mill hopper and auger
by _____ e. Disassemble shaker and screens
by _____ f. Dismantle duct work to dryer
by _____ g. Dust down all duct work pipes
by _____ h. Pull belt from dust elevator
by _____ i. Pull buckets from chain elevator

All material to be held for evaluation by management. Label and stretchwrap clean out for use in future campaign. Total weight to be entered into inventory.
By _____

2. WASH

by _____ a. Start at elevators on top of builing, dust & chain
by _____ b. Wash down all duct work
by _____ c. Wash down mill hopper & auger
by _____ d. Wash and scrape Sprout Walden
by _____ e. Wash top of dryer
by _____ f. Wash down all platforms and walkways
by _____ g. Wash down blenders #1 and #2
by _____ h. Wash down oscillator and belt
by _____ i. Wash down dryer oven, belt and brush
by _____ j. Wash down pre-mixer
by _____ k. Wash down shker
by _____ l. Wash small Munson
by _____ m. Wash all portable hoppers
by _____ n. Wash down frame work in motors
by _____ o. Wash down bearing housing
by _____ p. Rinse all areas a - o

All material from wash to be labeled and moved to EPOC System. This wash should be evaluated by management prior to treatment.
BY _____

3. PROBLEM AREAS

by _____ a. Ribbon in pre-mixer, rotate shaft for inspection
by _____ b. Blades and clamps in paddle blenders, rotate shafts for inspection
by _____ c. Elevator housings top to bottom
by _____ d. Mill hoppers, auger, mill face
by _____ e. Oscillator and belt
by _____ f. Mill platform
by _____ g. Dryer
by _____ h. Shaker screens

Final inspection of all equipment and recycling of clean out and wash down.
By _____

All areas must be totally cleaned and checked by supervisor for shift on final inspections.

Figure 8-3. Pellet Mill System Cleanout Procedures

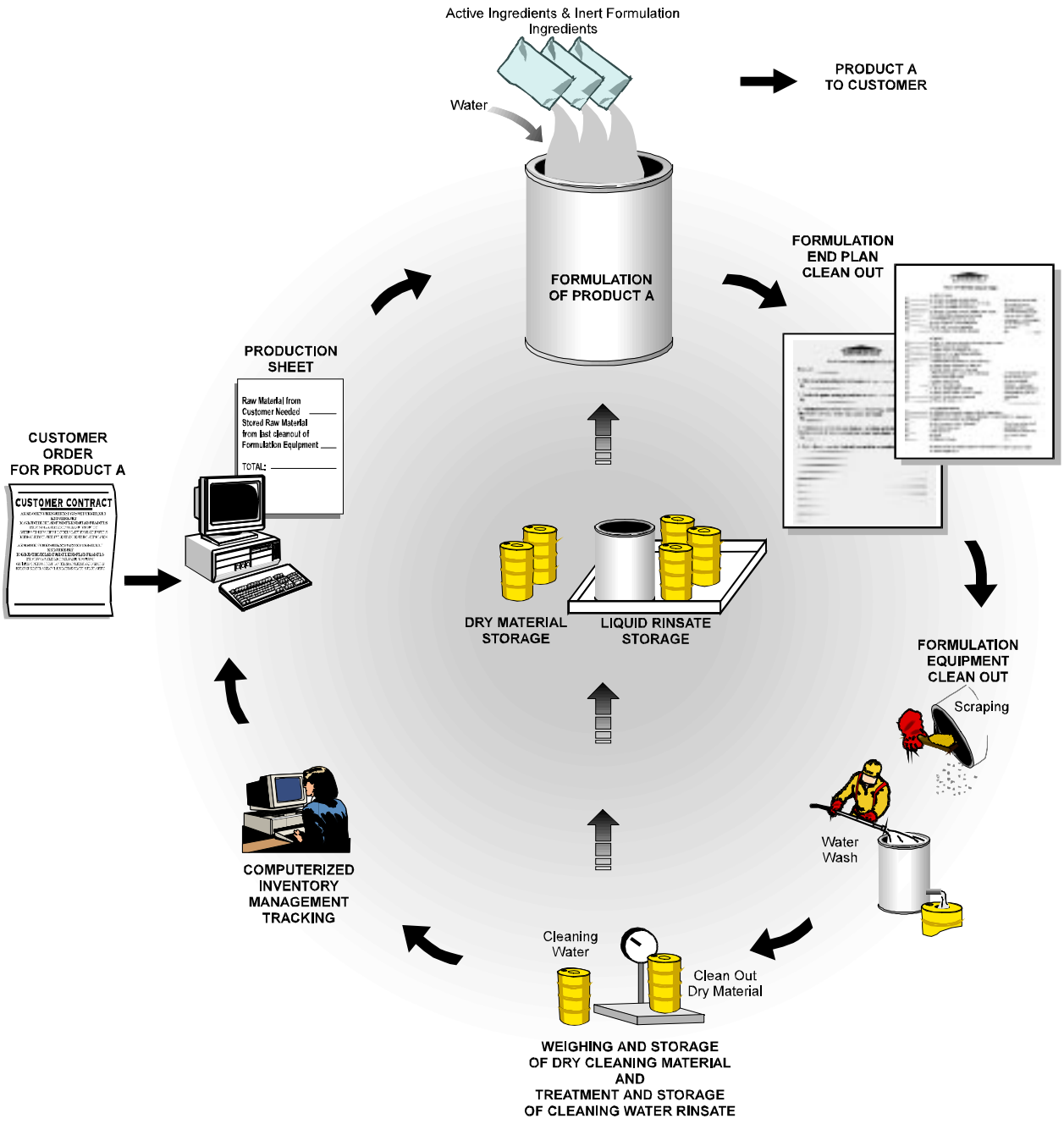

Figure 8-4. Pellet Mill System Cleaning Material Reuse Cycle

is collected in a sump and ultimately pumped back into the next product batch (solids, if present, are strained out). For example, four drums of marked "rinsate" were present in the mosquito growth-regulator briquets process area at the time of an EPA plant visit. This water was reused in the next formulation batch of the briquets.

Drum and Shipping Container Cleaning—Ennis Agrotech operated a ***drum rinsing station*** to minimize the generation of water from drum rinsing operations. Recently, however, the facility has implemented ***direct reuse of drum rinsate*** into product formulations. Drum shipping containers are triple-rinsed with the same solvent that is used in the formulation to which the drummed ingredient is being added. The solvent rinsate is added to the formulation at the time of the formulation. The drums are then disposed of according to the customer's instructions.

Spill and Leak Cleanup—Ennis Agrotech uses ***good housekeeping practices*** to reduce waste. Spills and leaks that may occur are cleaned up with adsorbent material, which is disposed of off site.

Other—Any wastewater that cannot be reused at Ennis Agrotech is disposed of off site at the direction of the client. Ennis Agrotech arranges for disposal based on the client's direction, pays the disposal bill, and then invoices the client. In some cases, Ennis Agrotech returns the wastewater to the client for ultimate disposal. For example, rinsate from tank trucks used to transport active ingredients is sometimes returned to the client.

Case Study 2: MGK, Chaska, Minnesota

Facility Overview

MGK operates a combination pesticide manufacturing and PFPR facility that produces manufacturing-use concentrates. These concentrates are sold to customers who formulate them into consumer products for household and lawn and garden use. The Chaska facility, constructed in 1992, currently includes one active ingredient manufacturing line dedicated to the production of MGK 264 (n-2-ethylhexyl bicycloheptene dicarboximide), although the facility plans to move additional manufacturing lines to this location in the future.

In addition, the facility operates several production lines used to formulate, package, and repackage products containing MGK 264, MGK 326, pyrethrins, and DEET. The PFPR portion of the Chaska plant consists of a formulating room, three packaging lines, and a warehousing area. MGK currently holds approximately 400 product registrations and typically formulates and packages 150 of those products in any one year.

PFPR Operations

The MGK Chaska facility uses MGK 264, as well as other active ingredients obtained from off-site sources, in the products formulated and packaged on site. Active ingredients used in formulations that are not manufactured on site are received in liquid and powder form. Liquid active ingredients are received in drums and are placed in a heated storage room to ensure the ingredient's

flowability until needed for a formulation. Powders are stored in a separate, enclosed dry formulations area for dust control. Solvent and inert ingredients are stored in a tank farm located behind the facility.

In the formulating area, raw material active ingredients are stored in dedicated day tanks with dedicated supply lines. The tanks are connected to two mixing stations equipped with weigh scales. When a custom formulation order is received, the required active ingredient is gravity fed through a dedicated line into a drum, which is positioned on one of the weigh cells. The appropriate amount of active ingredient, by weight, is pumped from the drum to a formulation tank, along with water or solvent and any inert ingredients. The volume of the formulation tanks ranges from 55 gallons to 6,500 gallons. If the volume of an order is small enough, it may be custom formulated in the appropriate size shipping container at the mixing station, instead of in a formulation tank. MGK's formulation tanks are dedicated to specific products or product groups based on estimated product volume requirements, product similarity, or product compatibility. Dedication of tanks minimizes the need for equipment cleaning between product formulations and maximizes the flexibility of operations.

Formulated product is pumped directly from the tank to the packaging line. MGK operates three packaging lines for formulated product. Product is packaged into bags, 5-gallon pails, 55-gallon drums, and tote bins. MGK also provides packaging in bulk form, and is considering 1-gallon packaging. MGK has the flexibility to reconfigure operations to meet the requirements of any custom formulation.

The solvent used in the MGK's formulations is methylene chloride. In the formulations area, a ***solvent recovery unit*** (still) is operated to recover methylene chloride used to clean equipment interiors and raw active ingredient drums.

Equipment for formulation of dry product is dedicated by chemical type, which eliminates the need for interior equipment cleaning. Methylene chloride is also used in this area to clean raw material tanks and drums, as necessary.

P2 Practices

MGK generates pesticide-containing wastewater associated with PFPR operations from three sources: (1) floor wash water; (2) exterior equipment cleaning rinsate; and (3) spill and leak cleanup. MGK also generates pesticide-containing solvent from two sources: (1) interior equipment cleaning; and (2) drum and shipping container rinsate. Noncontact wastewaters generated at the Chaska facility and stormwater are collected in a 40,000-gallon stormwater settling basin. These wastewaters are discharged directly without treatment through a dedicated sewer line separate from the wastewater sewer line that handles wastewater discharged from the pesticide manufacturing and PFPR areas.

MGK incorporated P2 into the original design of the facility and follows certain wastewater management techniques to achieve P2 at their facility. The benefits associated with these practices include:

1. Reduced raw material (i.e., active and inert formulation ingredient) costs due to recovery of these materials in rinsates.
2. Reduced disposal costs due to recovery of solvent used for cleaning formulation equipment and raw material drums.
3. Reduced water use; reduced hazards from slips, falls, and chemical residues; and decreased labor costs associated with floor cleaning through the use of a ***floor scrubber***.
4. Enhanced corporate image with the local community due to the implementation of practices that prevent or reduce pollution.
5. Reduced air emissions, leaks, and the need for drip pans through the use of welded joints instead of flanges in process piping.

Specifically, MGK uses the following P2 practices:

Interior Equipment Cleaning Rinsate—Although MGK product formulations include both solvent-based and water-based formulations, methylene chloride solvent is used for all interior equipment cleaning operations. The PFPR operations do not generate any interior equipment cleaning wastewater. A ***solvent recovery unit*** is operated in the PFPR area to recover methylene chloride for reuse in the formulating processes. The heel from the distillation unit is disposed of as hazardous waste.

In addition, waste associated with the formulating and packaging of a given product is minimized through the ***dedication of equipment***, ***production scheduling***, and ***formulating and packaging small batches in containers***. MGK Chaska also uses effective ***inventory management systems*** to maximize ***interior rinsate storage and reuse***.

MGK's Chaska facility uses dedication of equipment in a number of areas to reduce the need for cleaning equipment, thus reducing waste solvent from cleaning. Dry formulation equipment is dedicated, which eliminates the need to clean dry formulation equipment interiors. Many of the bulk raw material tanks and the piping leading from these tanks to formulating equipment are dedicated to a specific active ingredient, eliminating the need to clean these tanks and associated piping. Also, formulating equipment is dedicated by product family to reduce the need to clean these tanks and to reduce the possibility of cross-contamination between incompatible products. The facility also dedicates totes used for special formulations to the specific customer and formulation.

The facility also schedules production runs to minimize the need to clean formulation equipment. For example, the facility may schedule the production of two different products containing the same active ingredients but at different concentrations to immediately follow each other, eliminating the need to clean formulation equipment between the production runs.

MGK formulates small batches of product directly into 55-gallon drums. Piping that is dedicated by active ingredient feeds to a scale upon which 55-gallon drums can be placed. The appropriate weight of each active ingredient and inert is measured directly into the drum. This practice eliminates the use of a formulation tank and any associated formulation tank cleaning.

The facility also maintains an ***inventory management system*** for raw materials, products, and solvents that are recovered for reuse. A computerized system is used to keep track of raw materials and products, and to optimize production runs to minimize cleanings for product changeovers. The facility also maintains water meters throughout the facility, so that the amount of water used by the facility used for specific purposes, such as sanitary waters or cleaning water, can be determined.

Drum/Shipping Container Rinsate—Active ingredient drums are triple-rinsed with methylene chloride, and the methylene chloride is recovered in the ***solvent recovery*** unit for reuse in PFPR operations. ***Flow reduction equipment*** (i.e., spray guns) are used to rinse drums to improve the level of cleaning and to reduce the amount of solvent used in cleaning operations.

Floor Wash Water—The MGK Chaska facility was specifically designed to allow enough clearance to use a ***floor scrubber***. This mechanical floor washer, which operates on a 5-gallon recycled reservoir containing water and detergent, is used to clean the floors in the PFPR area. When this reservoir is replaced with new water and detergent, the spent cleaning solution is dumped in the floor drains in the MGK 264 or PFPR process area. In MGK's older facilities, the floors, which are sloped to a center drain, are sprayed down with water and soap. Facility personnel stated that this method takes longer and has more labor cost associated with it, and the floors tend to be more slippery.

Exterior Equipment Cleaning Rinsate—In addition, when deemed necessary by plant personnel, a complete floor and equipment wash is conducted by spraying walls, floors, and equipment exteriors with water from a hose equipped with a ***spray nozzle***. This cleaning is typically conducted once per month. The MGK 264 floor drains, as well as the floor drains in the PFPR area, feed into an equalization tank, located in the MGK 264 area, which is ultimately discharged to the local POTW.

Spill and Leak Cleanup—Incorporation of ***good housekeeping practices*** at the facility provides the facility with additional pollution prevention as well as other benefits. Daily inspection of tanks and equipment for leaks is conducted, and leaks and spills are cleaned up as quickly as possible after being discovered. In addition, the facility incorporated welded joints instead of flanges into the facility's design wherever possible to reduce the potential for leaks and to reduce air emissions. Regularly scheduled maintenance is performed on valves and fittings. The facility was also designed as a closed facility to minimize the accumulation of dust. When appropriate, material from spill and leak cleanup operations are processed through the ***solvent recovery unit***.

Other—MGK Chaska has incorporated ***training and written standard operation procedures*** into PFPR operations. Facility employees are provided with initial training as well as yearly refresher training, which includes training in pollution prevention and waste minimization. In addition, the facility conducts bimonthly meetings at which pollution prevention topics are emphasized. Records of employee training are maintained at the facility. In addition, the facility has an employee incentive program that bases employee bonuses, in part, on adherence to pollution prevention procedures.

Documentation of P2 practices include written P2 plans and procedures, records of facility maintenance and inspections, such as floor washes, and daily inspections for leaks and spills.